National Aeronautics and Space Administration

Space Technology
Game Changing Development
Next Generation Life Support: Spacecraft Oxygen Recovery (SCOR)

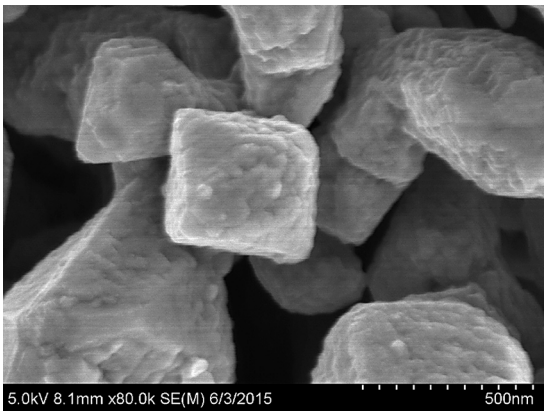
NASAfacts

The Next Generation Life Support Spacecraft Oxygen Recovery (SCOR) project element is dedicated to developing technology that enables oxygen recovery from metabolically produced carbon dioxide in space habitats. The state-of-the-art system on the International Space Station uses Sabatier technology to recover ~50% oxygen from carbon dioxide. The remaining oxygen required for crew respiration is supplied from Earth. For long-duration manned missions beyond low-Earth orbit, resupply of oxygen becomes economically and logistically prohibitive. To mitigate these challenges, the SCOR project element is targeting development of technology to increase the recovery of oxygen to 75% or more, thereby reducing the total oxygen resupply required for future missions.

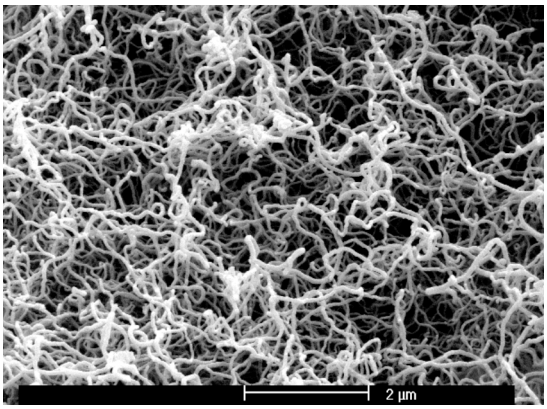
Four candidate technology approaches have been competitively selected for Phase I development, which will be completed mid-2016. In addition to NASA scientists and engineers, development teams include members from both industry and academia.

The University of Texas at Arlington is developing a microfluidic electrochemical reactor designed to recover oxygen from carbon dioxide through carbon dioxide electrolysis. In this approach, oxygen is released directly to the cabin while byproduct hydrocarbons may be discarded or stored for other purposes. The team will lean on its considerable experience in electrode development and fabrication to optimize an electrochemical cell designed to operate at room temperature and pressures and achieve approximately 77% recovery of oxygen.

Engineers at NASA's Glenn Research Center have teamed with a small business, PH Matter, LLC, Columbus, Ohio, to develop an oxygen recovery system comprising a high-temperature solid oxide co-electrolyzer (SOCE) combined with a carbon formation reactor. The SOCE produces oxygen directly from the co-electrolysis of water and carbon dioxide. The



Scanning electron microscopy image of catalyst crystals electrodeposited within UT-Arlington's microfluidic electrochemical reactor.



Scanning electron microscopy image of carbon formed on catalyst prepared using PH Matter's proprietary formulation and preparation technique.

carbon formation reactor employs catalyst formulations and preparation techniques to achieve nearly 100% recovery of oxygen.

Engineers at UMPQUA Research Company, Myrtle Creek, Oregon, are investigating a continuous Bosch reactor technology in which oxygen is recovered from carbon dioxide in the form of water using catalysts developed in-house at its research facility. A water electrolysis unit is operated in tandem to provide oxygen to the crew. The continuous Bosch reactor operates at high temperatures to achieve nearly 100% recovery of oxygen.

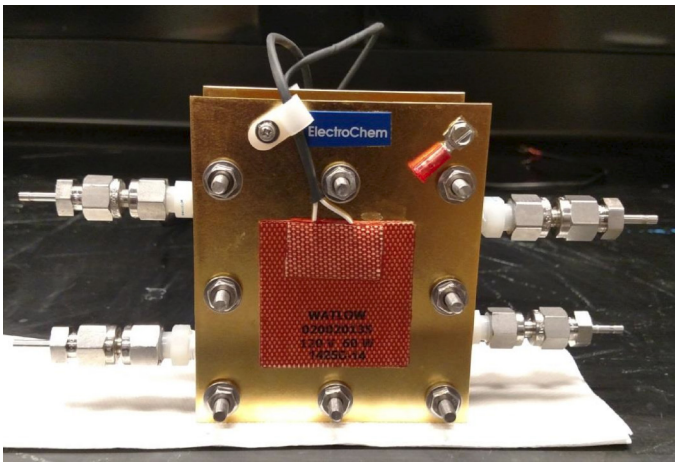
Finally, a second group of engineers at NASA's Glenn Research Center have teamed with University of Delaware to investigate an approach combining an ion exchange membrane electrolysis unit and a carbon formation reactor. The room-temperature electrolysis unit, developed at the University of Delaware, employs an ion exchange membrane in which oxygen is electrolytically produced directly from carbon dioxide, also producing carbon monoxide as a byproduct. The oxygen is provided to the crew and the carbon monoxide is directed to the carbon formation reactor, resulting in nearly 100% recovery of oxygen.

Following completion of the Phase I development efforts, each team will propose a Phase II activity to further advance respective technologies. Up to two technologies will be competitively selected for further development through 2018.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/

Carbon-coated catalyst developed for UMPQUA's continuous Bosch reactor.



University of Delaware ion exchange membrane electrolysis unit.

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